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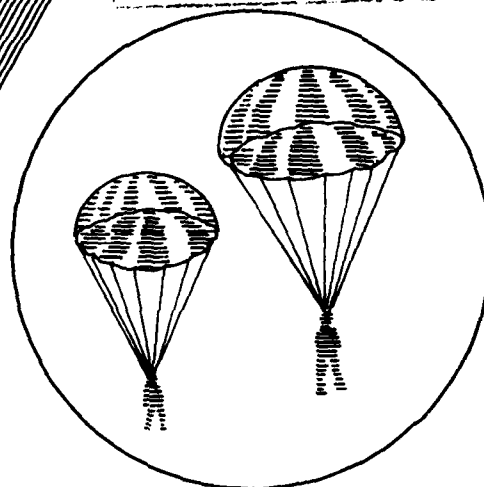
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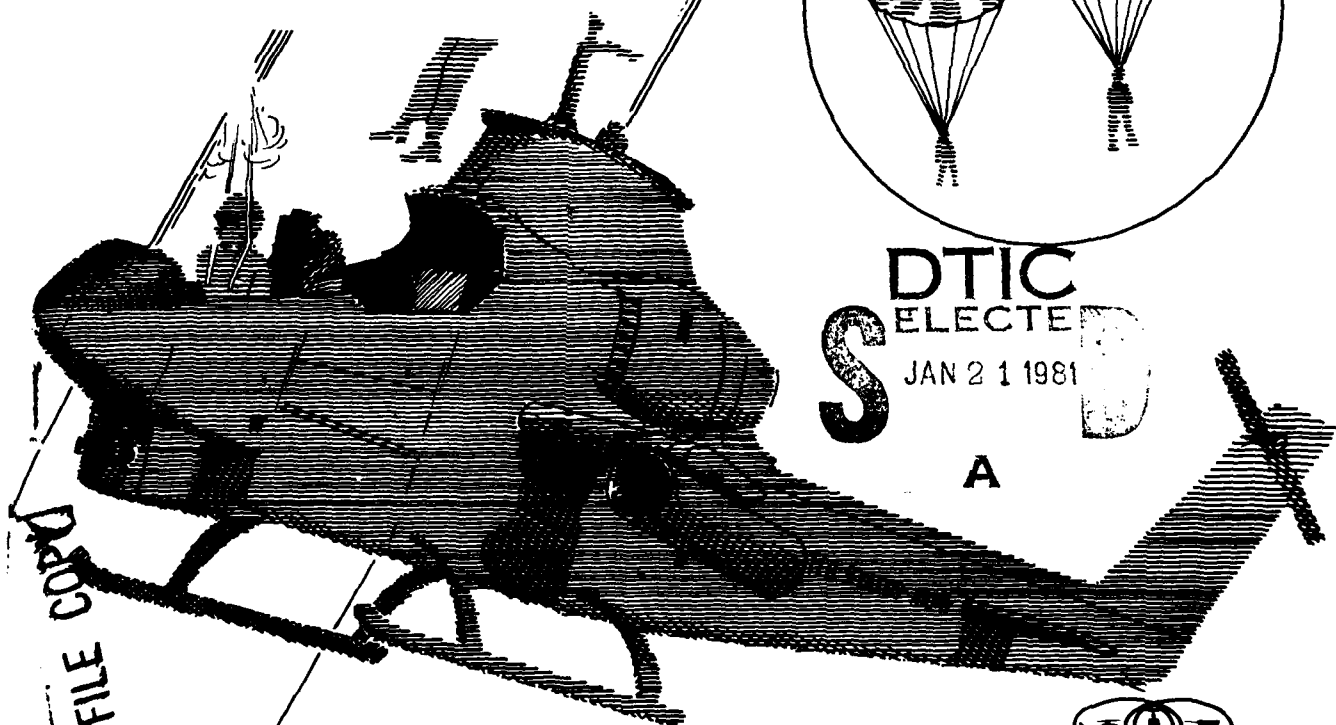
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**AH-1 HELICOPTER IN-FLIGHT ESCAPE SYSTEM:  
A VIEW FROM THE SEAT**

by  
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**DIRECTORATE FOR  
INVESTIGATION, ANALYSIS & RESEARCH**



**U.S. ARMY SAFETY CENTER**

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in-flight escape system, and (c) 60% of the pilots had experienced in-flight situations in which they felt the tension and anxiety would have been reduced had an in-flight escape system been available.

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## FOREWORD

Pilots of fixed wing aircraft have historically been resistant to accept in-flight escape systems. Prime examples are the parachute during the first quarter of the century and ejection seats in the late 1940's. Many pilots did not survive in-flight emergencies because they stayed with their aircraft too long. It is not known whether this extreme reluctance was due to fear, lack of confidence in the escape system, or prior conditioning to rely on forced landings. It has taken almost a new generation of aircraft and aviators to reduce this reluctance. In contrast, military rotary wing aviation has never had a system of in-flight escape. However, statistics indicate a need for such a system, especially in attack models. This report presents a survey of the opinions of aviators who fly attack helicopters concerning the need for an in-flight escape system. The findings of this study show there are emergencies in which attack helicopter pilots feel they need and, if available, would not be reluctant to use, such a system. These findings are surprising because rotary wing aviators have not been oriented through instruction or experience toward in-flight escape. It was also found that AH-1 pilots would not "punch out" indiscriminantly but would first attempt other emergency procedures. It is concluded that attack helicopter pilots feel an in-flight escape system is needed and they are more than willing to accept such a system.

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**Introduction.** A basic philosophy of fixed wing (F/W) aviation has been to provide the capability for in-flight escape. This capability is not provided in rotary wing (R/W) aircraft. Therefore, an equal probability of survival is not afforded helicopter occupants for in-flight situations involving loss of control or power precluding safe landing. Studies of AH-1G helicopter accidents were reviewed. These studies indicate many fatalities could have been prevented had an in-flight escape system been used.

Prototype development and testing of an AH-1 in-flight escape (extraction) system has been accomplished under a joint Army-Navy program (Sabatini, 1974). Further development is required before the system becomes acceptable. A Navy request for proposal (RFP) has been issued to industry. However, the Army presently has no plans to include the escape system in the AH-1 or advanced attack helicopter.

The purpose of this study was to determine how the "man in the seat" perceives the need for and use of an in-flight escape system in the attack helicopter.

**Method.** A questionnaire was developed which included brief descriptions of 25 actual AH-1 accidents. Only accidents with at least one fatal or major injury were selected. Each brief was assessed by 152 AH-1 aviators. They were instructed to determine from reading each brief (a) if they thought there was sufficient time to activate a proposed in-flight escape system before impact, (b) their estimate of the effect injury would have on ability to activate the system, and (c) whether they would have elected to use the system during the situations described. The questionnaire contained 10 additional questions concerning their background experience in AH-1 aircraft and general opinion of in-flight escape systems. During analysis, the accident briefs were categorized according to general types of in-flight emergencies. Eight types of emergencies were identified, each descriptive of one or more briefs.

**Results and Discussion.** Analysis of responses indicates AH-1 pilots perceive a need

for an in-flight escape system to improve their chances of surviving certain emergency situations. For some of the eight emergency circumstances studied, the briefs did not provide enough information for decisive responses. The most clearly demonstrated need was for those situations involving loss of aircraft control or power loss in which circumstances precluded safe landing. These results show (a) many AH-1 pilots feel they need a R/W in-flight escape system and (b) a number of AH-1 pilots have been fatally injured because of the absence of such a system. Preventable fatalities and injuries in R/W accidents will continue to occur without this method of escape. Knowledge concerning preventable fatalities and injuries creates serious moral, ethical, and legal implications. These implications and the findings of this study are important considerations for those determining the requirement for R/W in-flight escape systems. Recent lawsuits involving fatalities resulting from "human factor design negligence" are prime examples. The results of the study were strengthened by responses to a question in which 94 percent of the pilots surveyed responded that *all attack helicopters should be equipped with an in-flight escape system*. Responses to another question showed nearly 60 percent of the pilots had experienced in-flight situations in which they felt *tension and anxiety would have been reduced had an in-flight escape system been available*. This is a significant finding as tension and anxiety have a serious effect on an individual's motor skills and central processes, i.e., judgment and decisionmaking (Army Correspondence Course, 1975).

**Conclusions.** Unlike F/W aviation, R/W aviation does not provide the capability for in-flight escape. Previous studies indicated a number of AH-1 helicopter fatalities could have been prevented had an in-flight escape system been used. The AH-1 pilots in this study felt certain emergencies require a system for in-flight escape. Incorporation of such a system should reduce fatalities and injuries associated with R/W accidents.

Should an in-flight escape system be incorporated in gunship type helicopters, the individual escape system offers the most practical approach to in-flight escape (Meek, 1974). Technical feasibility of this type system has been demonstrated through joint Army-Navy developmental efforts. Navy plans are to incorporate the in-flight escape (extraction) system in AH-1J helicopters for the Marine Corps (Staats, 1973).

**Recommendations.**

- The results of this report be considered in the determination of the need for R/W in-flight escape systems.
- A study be initiated to determine R/W in-flight escape system needs, using current (1971-1975) accident data. The purpose of this investigation would be to further define the frequency and type of flight conditions which

warrant use of the system.

- A study be conducted to determine what effects tension and anxiety have on an aviator's flight task performance. The results of the study can be used to identify the benefits a R/W escape would provide in reducing these performance-inhibiting factors. In addition, the findings should identify methods for eliminating or reducing the debilitating effects of tension and anxiety in other areas of the aviation system.
- Particular attention be directed at assessing the moral, ethical, and legal implications of not providing a R/W in-flight escape system. Recent lawsuits involving fatalities resulting from "human factor design negligence" highlight the need for these considerations. Similar circumstances and charges can arise from R/W accident fatalities and injuries which could have been prevented had an in-flight escape system been available.





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# AH-1 HELICOPTER IN-FLIGHT ESCAPE SYSTEM: A VIEW FROM THE SEAT

## INTRODUCTION

**Need for System.** Increasing the chance of surviving in-flight emergencies is a chronic problem in the aviation world. Past performance of aircraft escape systems has increased the chance of survival. However, maintaining or increasing survivability is a continuous and complex task. Current and prospective escape systems must constantly be assessed to provide a technology which progressively evolves with changes in aircraft design.

In-flight escape systems have been relatively successful in reducing casualties associated with F/W in-flight emergencies. From 1960 to 1970, F/W escape systems have prevented over 2,800 military pilot fatalities (Baker, 1971). In contrast, R/W aircraft, which produce higher fatality rates, do not have a system of in-flight escape (AGARD-AR-62, 1973). Autorotation remains the helicopter pilot's primary means for making a survivable landing after certain in-flight emergencies.

Gessow and Myers (1967) defined autorotation as the condition of flight where the lifting rotor is driven in rotation by air forces, with no power being supplied through the rotor shaft. Landing safely by such a procedure usually requires considerable proficiency when conditions are other than optimum. Adverse landing site conditions, with respect to terrain and wind, contribute the greatest hazards (AMCP 706-204, 1974).

The primary reason for autorotation is to deal with specific in-flight emergencies, i.e., partial or total engine failure and certain tail rotor malfunctions. There are many situations which are not conducive to use of the autorotative procedure. Some of these are loss of main or tail rotor blade(s), transmission freezeup, combat damage to multiple control systems, pilot disorientation, terrain unsuitable for landing, instrument failure, icing conditions, or lack of adequate facilities to complete an instrument approach during instrument flight conditions

(AGARD-AR-62, 1973). In short, when the pilot loses aircraft control under these and other circumstances, he has no acceptable alternative but to remain with the aircraft to impact.

The shortcomings of reliance on autorotation have been demonstrated by Army and Navy R/W accident statistics. Senderoff (1971) analyzed personnel survival from combined Navy, Marine Corps, and Army helicopter accidents for the period 1958-1968. Results indicate the availability of an in-flight escape system would have averted approximately half of the fatalities. Baker (1971) determined 61 percent of AH-1G fatalities (1967-1970) could have been prevented by means of an in-flight escape system. This loss of personnel and the tremendous costs incurred by these losses are a clear concern for all involved in helicopter aviation.

To increase crew survivability, the Army has focused its attention on enhancing autorotative characteristics and crashworthiness of its R/W aircraft. This approach has been beneficial, but the above statistics indicate the requirement for an in-flight escape system. Recent research investigating this requirement has been directed at the AH-1. The basic rationale for this research is:

a. *AH-1 helicopters rely primarily on autorotation to recover from certain in-flight emergencies. This emergency procedure is relatively ineffective in providing an acceptable probability of survival for some AH-1 emergencies because:*

(1) *As an attack aircraft, it is often required to operate at combination of altitude and airspeed (NOE or low level) too low for safe power-off landings.*

(2) *Many missions are flown over terrain which would not permit safe emergency landings.*

(3) *In future combat missions, the AH-1 is expected to fly offensive strikes in the face of counterfire and antiaircraft weaponry. Many of these flights are expected to be outside*

the flight envelope necessary for safe power-off landing. Many combat damage emergencies preclude controlled descent.

(4) The pilot cannot reliably depend on autorotation to counter in-flight emergencies other than loss of power and certain antitorque malfunctions.

(5) Most loss of power autorotations are performed safely. But, for some of these emergencies, pilot error places the aircraft in adverse circumstances precluding safe autorotational landing.

b. Research indicates many fatalities occurring in AH-1 aircraft could have been prevented with an in-flight escape system. From September 1967 to September 1972, 210 Army and 10 Marine Corps Cobra pilots were killed in Vietnam. In 1969 and early 1970, U.S. forces lost an average of seven Cobra helicopter pilots per month in Vietnam. A Navy analysis indicated that in-flight escape systems could have prevented 6 out of every 10 of these Cobra pilot deaths (Staats, 1973).

**System Development.** In 1972, the Army and Navy jointly funded an in-flight escape extraction system development program for the AH-1. A Navy study (Sabatini, 1974) reports that an escape subsystem consisting of individual in-flight extraction systems has been developed. Also, a ballistic rotor blade severance subsystem which provides a clear escape path for extraction was near final development. This joint program was terminated in November of 1973 (Navy Message R231807Z Nov 73). Based on the success of the program, the Navy has plans to incorporate the system in AH-1J helicopters to be procured for the Marine Corps (Staats, 1973). A Navy request for proposal (RFP) has been issued to industry. The Army is monitoring the Navy's efforts, but has no plans to include an escape system in its AH-1 or advanced attack helicopter.

**System Limitations.** Modifications which add weight, use space, or require power would affect the operational performance of any aircraft. Past reluctance to accept an in-flight escape system for the AH-1 appeared to be based on (1) its degrading effect on performance and (2) lack of proof that systems under consideration could provide escape during low-level or NOE flights. However, results of the joint Army-Navy development program show

these stringent requirements can be met (Staats, 1973). The Navy RFP issued to industry requires successful escape during unusual attitudes, at zero altitude-zero airspeed (0-0), and a total system weight below 100 pounds. These capabilities and the opportunity to reduce fatalities and injuries are a strong argument for procuring such a system.

**Rationale for Study.** The requirement for in-flight escape systems in AH-1 aircraft appears firmly established by accident statistics. However, the decision to procure such a system is not simple and has been the subject of much debate. The purpose of this study was to determine how the "man in the seat" perceives the need for and use of an in-flight escape system.

## METHOD

**Participant Aviators.** One hundred and fifty-two AH-1 qualified helicopter pilots participated in the study. This total included 71 pilots from the 1st Cavalry Division, Ft. Hood, TX; 67 from the 101st Airborne Division (Air Assault), Ft. Campbell, KY; and 14 instructor pilots from the U.S. Army Aviation School, Ft. Rucker, AL.

A description of the aviators' backgrounds is presented in Appendix A. The average aviators surveyed had been rated 4 years, had more than 1,385 hours of R/W flight time, had 540 hours of flight time in the AH-1, and had experienced three AH-1 in-flight emergencies. Of the aviators experiencing in-flight emergencies, 20 percent listed crash damage to their aircraft and 7 percent reported crew injury resulting from the crash.

**Material.** The questionnaire was developed by U.S. Army Agency for Aviation Safety (USAAVS) research and aviator personnel (Appendix B). Each questionnaire consisted of three parts:

a. Instructions concerning the survey's purpose, capabilities of a proposed in-flight escape system, and procedures for completing the questionnaire.

b. Thirty-five questions which included:

(1) Twenty-five actual accident briefs (1970-72), less information about injury to crew, damage to aircraft, and survivability of the accident. It should be noted that a mini-

mum of one fatal or major injury was associated with each accident.

(2) Ten background questions concerning participants' experiences in AH-1 aircraft and general remarks regarding in-flight escape systems.

c. Answer sheet for participants' responses.

**Procedure.** Representatives from the 1st Cavalry Division, 101st Airborne Division, and USAAVNS were contacted to arrange for aviators to participate. A surveyor was then sent to the three military posts. The surveyor distributed the questionnaires and clarified instructions and procedures.

During a survey session, each participant was instructed to read the instructions and then answer the 35 questions. No time limit was imposed, but 1 hour and 30 minutes was sufficient at all three locations. Discussions were held after completion of the questionnaire to reduce the chance of biasing responses.

**Questionnaire Analysis.** Questionnaire analysis was completed in two steps. The first step was categorizing the accident briefs according to types of in-flight emergencies. The Delphi technique (Brown, 1968) was used to determine types of in-flight emergency conditions descriptive of the accident briefs. Basically, this technique is used for soliciting

the opinion of experts. For this study, the opinions of 10 USAAVS aviators were solicited through an intermediary concerning types of emergency conditions. Use of the intermediary reduced chances of response bias. The pilots identified eight categories (types) of emergencies, each descriptive of one or more briefs (table 1).

The second step was the statistical analysis of pilot responses. A questionnaire scoring technique similar to the "simple method of

**TABLE 1.—Identified Categories of In-Flight Emergencies**

Emergency Category	Accident Brief Number*
Tail rotor malfunctions	1, 15, 14, 16, 24, 5
Loss of engine power	18, 20, 21, 22, 23
Flight control malfunctions	9, 13, 25
Midair collisions	2, 8, 10
Disorientation vertigo	7, 12, 17
Late recovery	3, 4
In-flight collisions—terrain	6, 19
In-flight fire	11

\*See Appendix B

**TABLE 2.—Five-Point Scale**

**Time—**Would you have had sufficient time to activate an escape system prior to final impact?

Scale	Scores	Meaning
1	0.00-1.99	Yes
3	2.00-4.00	Undecided
5	4.01-5.00	No

**Injury—**How would injury affect your ability to activate the system?

Scale	Scores	Meaning
1	0.00-1.99	Uninjured—no effect on ability
3	2.00-4.00	Injured—effect on ability undecided
5	4.01-5.00	Injured—no ability

**Use—**Would you have used the system in this case?

Scale	Scores	Meaning
1	0.00-1.50	Yes, no hesitation
2	1.51-2.49	Yes, if other emergency procedures did not improve situation
3	2.50-3.50	Undecided
4	3.51-4.50	No, probably do better remaining with aircraft
5	4.51-5.00	No—no system used

Three scores for the questions on time, injury, and use were obtained for each accident brief. These scores represent a response pattern for the time, injury, and use questions,

## RESULTS

Briefs representing each emergency category tended to cluster under the same response pattern. Results also show that pilot responses produced scoring patterns absent of negative

**TABLE 3.—Distribution of Accident Briefs Across Scoring Patterns**

[illegible]

(4,5) responses. There was at least one indecisive or undecided element contained in scoring patterns VI through VIII.

#### DISCUSSION AND CONCLUSIONS

Results indicate AH-1 aviators need an in-flight escape system to improve survivability in certain AH-1 aircraft emergencies. This need was most clearly demonstrated for those emergency situations involving loss of aircraft control.

Further indications of pilot opinion supporting the need for a means of in-flight escape were (a) the absence of negative responses in accident brief scoring patterns and (b) responses to question 34 showing 94 percent of the aviators surveyed agreed *all attack helicopters should be equipped with an in-flight escape system.*

Responses to question 33 also strengthened these findings. Question 33 shows that nearly 60 percent of the pilots had experienced in-flight situations in which the *tension and anxiety would have been reduced had an in-flight escape system been available.* Five pilots commented on this in remarks to question 35 (Appendix D). This is a significant finding as tension and anxiety have a serious effect on an individual's motor skills and central processes, i.e., judgment and decision-making (Army Correspondence Course, 1975). Extraction capability may therefore be advantageous for purposes other than escape. Reduction of tension and anxiety should allow the pilot to channel more attention to the task at hand, thereby enhancing pilot performance. This benefit could be particularly important during NOE or low-level flights.

In these accidents alone, there were 27 fatalities and 21 injuries costing several million dollars. Autorotation was the primary means available for these pilots to accomplish a survival descent and landing. Many of the described emergencies were not conducive to this emergency procedures. Those emergency procedures which were implemented did not prevent injuries or fatalities. Viewed in terms of dollars, operating efficiency, or moral obligations, this loss of lives in aircraft mishaps where escape is possible is a serious and urgent problem.

Current developments by the U.S. Navy have demonstrated the technical feasibility of a sys-

tem of individual in-flight escape (extraction) for attack helicopters. However, further development is required to provide a system practical for use in Army attack helicopters. LT Baker (1972) clearly stated the problems remaining this way: "Can we have a cost-effective in-flight escape system which will take the monkey (risk) off the pilot's back—save a good many lives—and at the same time do so without unduly jeopardizing aircraft mission or operations?"

**Tail Rotor and Flight Control Malfunctions.** Accidents (briefs) comprising tail rotor (1, 5, 14, 15, 16, 24) and flight control malfunctions (9, 13, 25) collected under patterns I and II. Under pattern I, the pilots felt they would have used the escape system without hesitation. Pattern II shows pilots would have used the system if other emergency procedures were not successful. Responses show pilots felt there was sufficient time without injury to escape from the disabled aircraft in both patterns.

Degree of aircraft control may be the most reasonable explanation for these responses. Under the circumstances described in the briefs, the pilots probably felt (1) aircraft control could not be regained, leaving in-flight escape the only alternative, or (2) pilot technique may have maintained some control but, if not, they would have extracted before impact.

It can be concluded that in AH-1 pilot opinion an in-flight escape system would be needed for the described tail rotor and flight control malfunctions.

**Loss of Engine Power.** There were five briefs involving loss of engine power. Pattern III contained three of these briefs (20, 21, 22). Under this pattern, responses indicated 1—there was enough time for system activation, 1—ability to activate the system would not be affected, and 3—they were undecided whether they would have used the escape system. Responses to brief 18 (pattern II) also show there was sufficient time without injury for activating an escape system. But, in this pattern, the pilots felt they would have used the system had other emergency procedures failed. Pattern VI, which contains brief 23, indicated 3—pilots were undecided concerning amount of time for system activation, 1—no injuries affected ability to activate a system, and 3—they were undecided about use of the system.

In four of the engine power loss emergencies,

the pilots were undecided about use of an escape system. The high probability of safe autorotation is a logical explanation for their indecision. R/W pilots are trained from primary flight school that autorotation is the emergency procedure in the event of an engine power loss. Most pilots would probably feel capable of coping with an engine failure by riding it out, if the terrain below is at all suitable for landing.

These data indicate the pilots perceived a lower need for a system of escape during loss of engine power than for emergencies involving tail rotor and flight control malfunctions. However, should critical circumstances be imposed on the aircraft system by man, machine, or environment, the 0-0 capability of the extraction system could still provide escape for the crew. Such a system appears relevant for use in the mishaps because autorotation did not prevent fatalities or injuries.

**Midair Collisions.** Two of the briefs (2, 10) described as midair collisions were identified under pattern IV. Pilots felt 1—there was sufficient time to activate an escape system, 3—undecided concerning effect of injury on ability to activate a system, and 1—they would have used an escape system without hesitation. The third of the midair collisions (brief 8) fell under response pattern VII, showing indecision about time or injury but a definite indication they would have used the system.

Descriptions of the midair collisions were limited and probably accounts for their doubt about the effects of injury. The accident briefs did not make it clear the crew would retain the ability to activate an escape system following the emergency. However, in these midair collisions, the pilots felt if injury permitted they would have escaped without hesitation. Reason for this response might be the high probability of main rotor damage. In such cases, an in-flight escape system would be the most acceptable means for safe descent. It is concluded that the pilots felt an escape system was needed to counter the described midair collisions which did not affect ability to activate the system.

**Disorientation/Vertigo and Late Recovery.** Briefs (3, 4, 7, 12, 17) describing these mishaps grouped under pattern VI. Pilot opinion was undecided (a) about the amount of time available to escape and (b) if they would have used an escape system. The briefs involving disorientation/vertigo did not provide sufficient detail to determine if, as the pilot, they would have had a clear warning of impending danger. Late recoveries from firing runs had inadequate descriptions for them to ascertain whether as pilots they would have had sufficient time to use an escape system.

An in-flight escape system appears needed for disorientation/vertigo emergencies when the pilot has adequate warning of danger, and for late recovery emergencies when there is enough time for system use.

**In-Flight Collisions (Terrain).** The two briefs (6, 19) describing in-flight collisions with terrain were identified by response patterns V and VII. Pilots felt they would have used an escape system without hesitation in both cases but were undecided about the effects of injury or time on ability to activate the system. A reason for undecided responses is seen in brief 19. It is unclear in the brief whether there was adequate pilot reaction time for system activation. For these mishaps, responses indicate an in-flight escape system is needed when time or injury permits system use.

**In-Flight Fire.** Pilot responses to the one case of in-flight fire (pattern II—brief 11) show there was sufficient time without injury to activate the escape system before impact had other emergency procedures failed. Following a Mayday call, the crew of the AH-1G made a second call indicating they felt an open area near a river could be reached. Short of the area the aircraft struck a tree. In this situation, it appears the pilots surveyed felt their control techniques may have maneuvered the aircraft to the open area. In this case, the pilot's ability to maneuver the aircraft did not prevent a crash. An escape system could have provided escape for the crew when they realized a crash was inevitable.

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## APPENDIX A

### SUMMARY OF RESPONDEES' BACKGROUNDS

Years As Army Aviator		Flight Time R W Aircraft		Flight Time AH-1's	
1 yr. or less	4.6%	1-400 hrs.	3.9%	1-500 hrs.	16.4%
3 yrs.	50.6%	401-800 hrs.	12.5%	151-300 hrs.	15.7%
5 yrs.	31.5%	801-1200 hrs.	21.7%	301-450 hrs.	11.8%
7 yrs.	9.8%	1201-1600 hrs.	25.6%	451-600 hrs.	9.8%
9 yrs.	3.2%	1601-2000 hrs.	9.2%	601-750 hrs.	7.8%
		2001+ hrs.	26.9%	750+ hrs.	38.1%

In-Flight Emergencies: AH-1's Occurrences Experienced		Emergencies Resulting In Aircraft Damage Occurrences Experienced		Emergencies Resulting In Crew Injuries Occurrences Experienced	
One	19.2%	One	15.4%	One	4.1%
Two	15.2%	Two	2.0%	Two	0.0%
Three	13.9%	Three	2.0%	Three	2.7%
Four	11.2%	Four	1.0%	Four	0.0%
Five	3.3%	Five	0.0%	Five	0.0%
Six or more	10.6%	Six or more	0.0%	Six or more	0.0%
None	26.4%	None	79.1%	None	93.7%

#### Emergencies Where Escape System Would Have Been Used Had One Been Available Occurrences Experienced

No in-flight emergency	27.6%
None	58.5%
One	9.8%
Two	.6%
Three	1.3%
Four	.6%
Five	.6%
Six or more	.6%

#### In-Flight Situations Where the Existence of an Escape System Aboard Would Have Lessened the Tension and Anxiety by Offering an Alternative If Needed—Occurrences Experienced

One	22.5%
Two	11.2%
Three	11.9%
Four	2.6%
Five	.6%
Six or more	9.2%
None	41.7%

#### Should All Attack Helicopters Be Equipped With an In-Flight Escape System?

Strongly Agree	74.3%
Agree	19.7%
Undecided	3.9%
Disagree	1.9%
Strongly Disagree	0.0%

## APPENDIX B

### ATTACK HELICOPTER PILOT SURVEY

#### INSTRUCTIONS:

1. The purpose of this survey is to obtain your opinion regarding the feasibility of an in-flight emergency escape system for the attack helicopter.
2. The proposed system you are asked to consider, after activation by the crew, would sequence through three events:
  - a. First: Main rotor blade/hub severance (by a ballistic device) to provide a clear escape path for the crew.
  - b. Second: Canopy removal and crew extraction/ejection.
  - c. Third: Parachute deployment.
3. Don't overly concern yourself with the reliability or safety aspects of the system. The system will undergo the rigorous qualification and certification test required of all escape systems.
4. The time interval from system activation by the crew to full parachute inflation is approximately 1.7 seconds.
5. A helicopter cannot always be expected to maintain an ideal attitude nor altitude during emergency situations; therefore, it is necessary to mention a few of the performance capabilities required of the system. To enable you to make a realistic determination of the following twenty-five accident briefs, consider the in-flight escape system to possess the following capabilities:
  - a. 0 altitude and 0 airspeed capability.
  - b. 90° bank and nose level, 0 sink rate. Would require 100 ft. terrain clearance.
  - c. 180° bank (inverted) and nose level, 0 sink rate. Would require 200 ft. terrain clearance.
  - d. Wings level and 5° nose down, 1500 fpm sink rate, 150 kts airspeed. Would require 50 ft. terrain clearance.
  - e. Wings level and 15° nose down, 3000 fpm sink rate, 150 kts airspeed. Would require 150 ft. terrain clearance.
  - f. Wings level and 5° nose up, 0 sink rate, -40 kts airspeed. 0 ft. terrain clearance required.
6. Proceed to the twenty-five accident briefs. Make sure you answer all three (1 time, 2 injury, 3 use) questions for each brief. After completing the questions asked of the twenty-five accident briefs, answer the AH-1 background information questions, numbers 26 through 35. The interest and views of the AH-1 crews could very well influence the in-flight escape system being considered for the attack helicopters.

## ACCIDENT BRIEFS

**1**

AH-1G departed heliport at 0700 hours as the second aircraft in a flight of two; the other aircraft was a UH-1C. Their mission was a routine visual reconnaissance. The UH-1C was conducting low level reconnaissance while the AH-1G was covering him from an estimated altitude of 700-900 feet. Both aircraft had been on station approximately 20-30 minutes when a radio call went out over the unit's command UHF, "We are going down." Witnesses to the crash were flying generally west and a few hundred meters northwest of the crash site. The AH-1G was flying in the same direction almost directly over its final resting point. The aircraft went into an extreme nose low attitude. It then began to spin about its longitudinal axis. The direction of spin is unknown. AH-1G impacted the ground in vertical descent and exploded and burned on impact. The witnesses stated they think the main rotor separated from the aircraft prior to the impact.

**2**

Witnesses state it appeared that the O-2A in a climbing right hand turn, headed generally in a southwest direction, collided with the AH-1. The AH-1G was making left hand orbits and was in a shallow descent, estimated to be not more than 500 feet per minute. The board concluded that the two aircraft ran together contacting the left wing and cockpit area of the O-2A with the main rotor blades of the AH-1G. The aircraft did not hit exactly head-on but off center to the left of each respectively. On impact, the AH-1G main rotor system separated from the mast. The AH-1G fell to the ground without any noticeable tumble or gyrations. Just before impact with the ground, the AH-1G rolled to its right side.

**3**

AH-1G was part of a light fire team that was to perform a demonstration of the capabilities of aerial field artillery. The normal demonstration, which included several firing passes and a low level fly-by, was accomplished with only one incident. The wing ship on the fly-by came closer to the spectators than was necessary and barely missed a parked aircraft. After the fly-by, the ground controller gave the section an end of mission. The section leader approved a second fly-by. The section did not form up into a formation prior to the dive but were to form up while in the dive. The lead ship flew by the spectators while the wing ship took up a course approximately 60 degrees away from the spectators down range. He initiated a steep dive at approximately 700 feet. Appeared to attempt a recovery at 200 feet. The aircraft hit the ground, the skids and rocket pods broke off, both blades hit the ground, the aircraft bounced up approximately 10 feet and struck a 12-foot high berm. The berm flipped the aircraft end to end and it broke apart.

**4**

AH-1G was on a night cover mission over a low-flying UH-1H equipped with a xenon searchlight. The AH-1G, from an altitude somewhere between 800 to 1,000 feet, commenced its final dive into a generally south to north direction. The aircraft continued down its dive angle path, firing three pair of rockets and then a fourth pair. The aircraft at this time was at an extremely low altitude above the ground. After the last pair of rockets was fired the aircraft began a left turn, toward the northwest, to pull out of the firing pass dive. Apparently the pull out procedure was begun too close to the ground. As the aircraft struck the ground in level, left side low attitude, one main rotor blade apparently struck the ground or a tree to the left of the impact point, severing it. Another tree to the right side of the aircraft apparently severed the right skid and the vertical fin from the tail boom. The aircraft continued in a straight line direction and portions of it came to

rest directly down the avenue of impact. The initial contact point consisted of a 15-foot trench dug about 12 inches deep. The trench was straight and all wreckage lay in the same direction.

## 5

After a successful hover check facing into the wind's probable direction, the aircraft commander attempted a pinnacle type takeoff to the north. As the aircraft moved off the edge of the ridge, the pilot applied full left pedal and increased pitch to reduce sink and maintain a straight ground track. Torque was from 37 psi at the hover to 41 psi and engine rpm went to 6200. The aircraft started a slow yaw and turn to the right. The aircraft commander in attempting to maintain directional control placed an exaggerated left forward cyclic input to the rotor system. The aircraft continued to pivot to the right. The aircraft commander was facing approximately 180 degrees from his original direction of takeoff when he diverted his efforts toward returning to the pad. The aircraft completed a slow 360-degree turn and then made two quicker 360's; rotor rpm continued to decrease with loss of altitude. At approximately 5800 rpm and 100 feet altitude, the aircraft commander determined that he wasn't going to make it back to the pad. He rolled off the throttle and attempted an autorotation some 75 feet above the terrain. The aircraft fell some 40 to 50 feet due to minimum rotor rpm and low airspeed, and a possible early pitch pull.

## 6

At approximately 0545 hours, while still dark, the AH-1G struck the highest (about 230 feet msl (200 feet agl)) guy wires of an unlighted radio antenna tower. Top of the tower was 240 feet msl. The guy wires were severed and the top 12 feet of the tower were whipped off and fell to the ground. The whiplash effect of the cables smashed out most of the canopy, extensively damaged the main rotor blades, and severed the push-pull leading to the pitch change arm on one of the main rotor blades. The push-pull rod for the other blade was bent. The shattered plexiglass, severed push-pull rod and top left pylon access door separated. The helicopter went into a left hand descending turn and impacted in a level attitude 500 meters NE of the tower. The heading of the aircraft when it hit the ground was at approximately a right angle to the original flight path. The aircraft crashed on top of an 8-foot-wide raised pathway between rice paddies. It touched down perpendicular to the pathway, collapsing the landing gear, and came to rest on the bottom of the fuselage and the large right pocket pod.

## 7

The AH-1 was part of a hunter-killer team consisting of two AH-1G's, one UH-1H, and one OH-6A. The mission was a visual reconnaissance. Shortly before 0800 hours, the weather was determined to be marginal. The team leader flying an AH-1 instructed the team to hold on the 230 bearing from the non-directional beacon, at 1,500 feet, and he proceeded into the valley for further investigation of the weather. He entered the valley and visual contact was lost at 0812 hours between himself and the rest of the team. At approximately 0813 hours, he gave a pirep of 200 feet and 1,700 feet overcast. At 0815 hours, he reported rainshowers and the area unworkable. At 0816 hours, he informed the team that he was returning. At 0818 hours, he told the team to continue holding over the flatlands at 1,500 feet, and that he was IFR and was tracking inbound to the beacon on a 065 heading at 2,800 feet. That was the last transmission received from the aircraft. The aircraft was found in a ravine that was vegetated by single- and double-canopy jungle. The wreckage was scattered over an area approximately 300 meters long by 50 meters wide. The largest part of the aircraft remaining intact was the vertical stabilizer. The rest of the aircraft was torn into pieces no longer than eight by ten inches, scattered over an area approximately 300 meters long by 50 meters wide.

## 8

The fire team arrived on station at 2330 hours in trail formation, a circling orbit was set up, and was observed by ground troops who indicated the orbit got smaller and smaller. The last radio transmission monitored was that the lead aircraft was "rolling in hot." At this time, the troops on the ground observed a large flash of fire and some rockets being fired. The burning aircraft fell to the ground over a ridge line 800 meters from the ground troops who reported shortly after the flash of fire in the sky there was another flash on the ground over the ridge line. A pilot on the ground observed the orbit over the contact area and was watching the firing runs. He observed the large flash in the area of the aircraft and could no longer see the position lights of the aircraft. He went to the battery operations center and informed the personnel on duty of what might have happened. They initiated a radio search with negative results. Tactical operations center launched a search and rescue team in a UH-1H. Upon arriving at the scene, two fires were observed approximately 200 meters apart, and with close observation of the fires, it was determined that a midair collision had occurred.

## 9

As the AH-1G began a climbing departure from traffic at 80 knots and 500 fpm, both pilots heard a thump. This thump was best described as a noise heard when performing a hydraulics check during runup when the hydraulic system is turned back on with the controls slightly displaced. The pilot checked all of his instruments and flight controls and continued his climb to the west-northwest. As the aircraft reached approximately 4,000 feet msl, the pilot moved the cyclic forward to increase the airspeed to 100 knots for cruise flight. Upon application of forward cyclic, the pilot experienced severe feedback in the fore and aft cyclic and the aircraft began a slight dive. The pilot called the copilot to "get on the cyclic" to assist in controlling the aircraft. The pilot continued to receive severe feedback in the cyclic and was using both hands on the cyclic with the copilot controlling the collective and assisting on the cyclic. All other controls were functioning normally and the engine was normal with rotor and engine rpm in the green. The pilot was able to force the cyclic aft which placed the aircraft in a slight decelerating attitude and began a descent to an open field directly to his front. The pilot noticed that the aircraft was decelerating too rapidly and attempted to apply forward cyclic. The severe feedback and forces prevented him from doing so. The aircraft lost all forward airspeed approximately 100 meters short of the intended landing site at approximately 100 feet of altitude. The aircraft began falling through in a slightly tail low attitude and crashed into the trees. The aircraft impacted with approximately a 10- to 15-degree nose high attitude with the skids level with the horizon. At impact, the landing skid crosstube assembly failed causing the aircraft to roll to the left with the main rotor still turning. The roll to the left and subsequent stoppage of the rotor system severed all control linkage and caused extensive damage to the airframe. The transmission was torn completely out of its mounts.

## 10

A flight of two AH-1G aircraft arrived on station at the Fire Support Base (FSB) at approximately 2045 hours. At this time, the forward observer identified the target and requested the ARA make the firing passes from north to south. After obtaining the general location of friendly elements in the vicinity of the FSB, the AH-1's elected to make their firing runs from east to west to preclude overflying the friendly positions. During this period of time, a UH-1 was in a left-hand orbit around the FSB dropping flares. The AH-1 at this time was flying the right wing position of the lead AH-1 and following on the initial firing run from east to west. The ground element notified control that there was a possibility that a midair collision had occurred. The investigating board

feels that the following events took place: The UH-1H was engulfed by fire apparently caused by a flare malfunction. At this time, the UH-1H started a descent to the ground and in the process made contact with the AH-1G. This contact resulted in the loss of the UH-1H's rotor system while damaging the AH-1G. The AH-1G caught fire and the two aircraft separated. The UH-1H fell to the ground in flames while the AH-1G proceeded in what appeared to be an autorotative glide and crashed in heavily wooded and mountainous terrain.

## 11

AH-1 was en route home after a combat mission. The AH-1G was cruising at 2,000 feet with another aircraft in the attack section when it began billowing black and gray smoke. A Mayday call was made. The aircraft turned to an open area near a river and prior to contact a call was made by the crew that the area could be reached. Short of the clear area, the aircraft struck a tree, turned on its side, and fell to the ground.

## 12

The pilot was the lead aircraft of a flight of three. After 15 minutes of flight, it started to get dark and the flight entered a light rain. The pilot could clearly define a cloud bank ahead and started a descent to 500 feet. A short time later the ceiling dropped to 200 feet and the pilot had limited contact with the ground. The lead aircraft executed a 170° turn to the right; the pilot could see the river to his right side. At this time, the pilot turned toward the river. As the aircraft rolled completely out of the turn, the pilot noted airspeed indication of 70 knots and 150 feet of altitude. After a few seconds, the aircraft contacted the first large tree. After tree contact, the aircraft impacted in the river in an upright position and began to sink immediately.

## 13

At approximately 2230 hours on a test flight, AH-1G pilot radioed that he had a partial loss of cyclic control and was going down. A few seconds later he reported that he was going into a river at 190 knots without cyclic control.

## 14

AH-1G pilot transmitted that his tail rotor chip detector light had come on. About 10 seconds later, he again transmitted that he had experienced a tail rotor failure in a fixed pitch position and requested the airstrip be cleared for an immediate emergency landing. Almost immediately after his last transmission, the entire tail rotor and 90-degree gearbox assembly separated from the aircraft. The AH-1 then spiraled to the ground from about 150 feet agl impacting level. The crash site was approximately 500 meters from the end of the airstrip.

## 15

Shortly after takeoff, the pilot transmitted a Mayday. He stated he had experienced a tail rotor failure and was returning home. An "inbound" Cobra heard the call and initiated a turn to pick up and escort the Cobra back to the airfield. The instructor pilot of the "inbound" ship saw the distressed aircraft spinning in what he thought to be a "clockwise" manner at an altitude of approximately 200 feet. At approximately 50 feet, he lost sight of the Cobra and then saw black smoke coming out of the trees.

## 16

AH-1G runup and hover to takeoff were normal. It departed at approximately 0800 hours and began a normal climbout. As it passed over the perimeter wire at an altitude of approximately 150 feet above the ground, it was indicating 60 knots airspeed. At this time, a loud "pop" was heard from

the tail boom section of the aircraft. Parts were observed flying from the tail rotor area. The aircraft assumed a 35- to 45-degree right yaw and nose low attitude. The pilot immediately applied left pedal to correct the situation with no effect. The pilot lowered the collective pitch half way to bring the nose back to the left. The nose moved left slightly and stabilized for 4 to 5 seconds. The ship descended toward a large rice paddy at the bottom of a 150-foot slope. At about 150 feet altitude above the rice paddy, the aircraft began a spin to the right. The rate of spin increased during descent and was violent at impact. When the aircraft entered the spin, the pilot completely lowered the collective pitch and centered the cyclic to keep the skids level. The wing stores were not jettisoned. The aircraft contacted the ground coming almost straight down in a fairly skid level attitude. It broke apart and rolled on its right side.

## 17

Two AH-1's were released from their mission at 2100 hours to return home. The weather condition being marginal at that time required the two crews to request and receive a GCA into a refueling area. After refueling, the flight leader suggested the flight try to low-level down a highway en route home. His wing pilot agreed. After departing, the wing pilot informed the flight leader that the weather was too bad and he was returning to the refueling area. The flight leader replied that he also was returning. Upon landing, the wing pilot asked the tower operator if he had the flight leader in sight and the tower operator replied he did not. Efforts to contact the flight leader were negative. The aircraft was located the following morning at 0700 hours by an SAR aircraft. The aircraft had struck the ground, under power in a shallow descending right turn destroying the aircraft.

## 18

Flying at an altitude of 100 feet agl and 100 knots, the AH-1G pilot heard an explosion aft of the pilot's compartment and noted the engine and rotor rpm decreasing rapidly. He lowered collective and began a flare to build the rotor rpm as well as dissipate air and ground speed. Just as the rotor rpm began to build as he got off a short radio transmission to the lead aircraft, first impact was made. At the time of the mishap, the aircraft was on a heading of 258° with the wind direction from 050° at 15 knots gusting to 18 knots, giving a right quartering tailwind. At impact, the pilot applied maximum collective to cushion the landing, but the aircraft was traveling at 65-75 knots indicated airspeed. The aircraft impacted in a wooded area with such forward speed that it traveled 300 feet, tearing down trees and brush, before hitting a rice paddy dike which caused the aircraft to flip and land inverted.

## 19

The AH-1G flew over a finger of trees which was part of the northern wood line that surrounded a clearing. The target was situated by a wood line on the road. The tail rotor struck a tree and flew off due to sudden stoppage. The nose came slightly left and up. It then yawed almost 90° to the right. Aircraft then started to separate and come apart in the air. Black smoke began to rise shortly before the aircraft struck the ground. It burst into flames upon impact.

## 20

At 1130 hours, an AH-1G was launched to provide aerial fire in a landing zone just prior to a combat assault by a flight of UH-1H aircraft. At approximately 900-1000 feet agl, the crew noted a grinding noise just prior to an explosion. The engine gauges had given no warning of possible engine malfunction. After the explosion, all instruments indicated that the engine had failed. The copilot initially entered autorotation and relinquished control of the aircraft to the pilot. The copilot made a radio call and tried unsuccessfully to jettison the stores. Because the pilot had never performed an autorotation from the front seat, he turned control back to the copilot. The

copilot continued the autorotation straight ahead toward what appeared to be a sandbar on a creek bed. The pilot did not attempt to jettison the stores from the front seat because of the time factor and altitude lost. As the aircraft approached the intended landing area, the copilot noted that several trees were blocking the approach path and pulled some pitch to clear the trees. On short final, he realized that the landing site was covered with large rocks and decided on a minimum ground run autorotative landing. The copilot zeroed the airspeed and pulled initial pitch at approximately seven to ten feet. The rotor rpm had decayed. The aircraft fell through and landed hard, causing major structural damage.

## 21

AH-1G was on a visual reconnaissance mission when it experienced engine failure. The pilot reported his initial difficulties by twice calling "going down" to an accompanying LOH that was flying recon at treetop level in the same area. The LOH immediately climbed to altitude to relay the message to troop operations and to follow the AH-1G down. The AH-1G, estimated to be at 2,000 feet approximately 2 kilometers north-northwest of a large open field, appeared to be in a normal autorotative glide at approximately 500 feet indicated as it descended below the LOH. The LOH pilot monitored emergency procedures called off by the AH-1G after their initial transmission. While still over the trees, the aircraft was observed to assume a radical decelerating attitude with a subsequent loss of airspeed and rotor rpm. The aircraft's momentum carried it just clear of the trees where it settled vertically with zero airspeed and rotor rpm.

## 22

AH-1G was on a night security mission. At 0150 hours, the pilot was conducting a transponder check at 3,000 feet. The copilot was at the controls at this time. He noted flickering master caution and chip detector lights and immediately informed the pilot of his observation. The pilot took control of the aircraft. At this time, the master caution and engine chip detector lights came on and the engine failed. The pilot determined that he had sufficient altitude to make the active runway his touchdown point. Several distress calls were made during his autorotation but he didn't remember getting a reply from any of them. At the time of the engine failure, approximately fifty percent of the tire pots that illuminate the active runway were not operational. The pilot had a great deal of difficulty in seeing the intended point of touchdown and in judging rate of closure. The copilot advised the pilot when to start his deceleration. The pilot had both landing and search lights on and pulled pitch on his initial visual contact with the ground. He continued to pull pitch and decelerate until the rotor rpm bled off to the point where he no longer had control of the aircraft. The aircraft descended vertically with no airspeed nor cushioning effect from about 20 feet above the ground. The aircraft landed extremely hard, bounced, and turned 90° to the left and remained upright.

## 23

AH-1G was on a scramble to furnish support for a downed aircraft. At 1730 hours as the pilot began his takeoff, the aircraft yawed slightly but returned to normal; then as he broke through translational lift the engine failed. The pilot had to make a very quick and accurate decision, while in the "dead man's zone," with a loaded gunship. Avoiding people, aircraft to his front, who were also scrambling, he turned sharply to the right as he lost altitude, pulling pitch to miss a building full of people and flaring to miss others. He took vertical descent to spare those on the ground. While in his turn, flare, pitch-pull maneuver, the heavily loaded AH-1G hit the ground, nose low and almost no rotor rpm. The slow turning blade hit the ground and bounced back through the canopy, severing the pilot's right hand. At the same time, the aircraft hit the ground sliding sideways to the left and slightly to the rear, tearing the skids off and the main rotor was torn off the mast. The tail rotor and 90° gearbox left the bird, and one blade went up the exhaust stack. The 90° gearbox and remaining blade landed approximately 150 feet from the bird.



## 24

At about 2200 hours that night, word was received that a Vietnamese outpost was being attacked. Two AH-1's went to aid the outpost. After expending their rockets, they returned home. The team returned to the area and began to make rocket attacks on the enemy positions. During the third gunrun, just as he was about to initiate recovery from the dive, the pilot's canopy door sprung open. At that moment, they were between 1,000 and 1,200 feet altitude and about 160 knots IAS. The copilot reached for the controls. He had become startled and thought that the pilot had been wounded. He looked back over his right shoulder and saw the pilot reaching out to close the door. The door then tore away and flew up into the main rotor blades. Both pilots noticed while this was happening that the SCAS had been disengaged. The pilot had become aware of this through the blinking of his SCAS lights and the copilot by the feel of the controls. The pilot radioed, "Going down, lost tail rotor, canopy came off." The master caution light came on. The aircraft, now between 500 and 700 feet altitude, had slowed in airspeed and was yawing to the right. The copilot noticed the yaw but stated no CG problem existed. The pilot also claimed no CG problem, though he knew by now that the tail rotor had been damaged and was not providing thrust. He believed that they still retained the 90° gearbox. With the aircraft's airspeed now down to 50 knots, the pilot put in forward cyclic, leaving his torque setting alone. As airspeed increased, the aircraft turned smoothly to the right and began to streamline. Copilot stated that this occurred at 90-110 knots, whereas the pilot thought it to be more around 120 knots. Since the aircraft was now stable, the pilot decided to fly back home to make a running landing. His altitude was 300 feet. He radioed to the other aircraft that he had the ship under control and was going home. After having leveled off at an airspeed of 140 knots, the helicopter began to yaw to the right and roll left into about a 90° bank. At this time, the pilot applied hard right cyclic to overcome this condition. He radioed, "Going inverted." The roll was eliminated, but the yawing tendency increased. The pilot described the unwanted maneuver as virtually flying sideways. The aircraft then began to fly backwards in a tail low attitude. Copilot recollected the attitude to be about 20° tail low and lasted for approximately five seconds. During this time, additional altitude had been lost. The pilot then applied full forward cyclic and the nose of the aircraft dipped and the aircraft spun to the right 360°. There was one possibly two complete turns. The pilot then pulled out of the erratic dive. As he leveled the helicopter, he noticed his airspeed to be zero and that the altitude above the ground was between 50 and 150 feet. He described the attitude as being at a "stable hover." After transmitting "zero airspeed," the aircraft once more began spinning to the right in a noncontinuous manner (the aircraft spun to the right 180°, stopped, and then quickly spun another 180° to the right). The aircraft then began spinning continuously 360°, increasing in velocity. The pilot reacted by cutting the throttle to which the aircraft responded by turning 270° to the right and then stopping. With altitude 10 to 15 feet above the ground, the pilot pulled the collective.

## 25

AH-1G entered mast bumping, causing the main rotor to separate. It was determined that the pilot was firing the weapons in preparation of the aircraft entering its eighth P.E. Although the witness statements are sketchy and in contradiction, it is safe to say that during a gunrun the pilot experienced a SCAS hardover in the pitch channel. This is evidenced by the statements saying the aircraft appeared to "tuck violently" and seemed to start to recover, then went out of control and fell straight down. When the main rotor left the aircraft, it impacted the tail rotor blades, taking one blade and tearing off the gross head and pitch change links. The 90° gearbox left prior to impact. From the direction the aircraft was diving, it yawed to the left after losing its blades. The aircraft impacted on its right skid and side. There were signs of only 3-4 feet of forward skidding on impact. It is believed the aircraft entered mast bumping from one or two causes or possibly a combination of both. First, the SCAS failure or hardover; and second, possible over-correction on the pilot's part causing the main rotor to flex down and impact the mast.

### AH-1 BACKGROUND INFORMATION

26. How many years have you been rated?
- |                   |            |                    |
|-------------------|------------|--------------------|
| 1. 1 year or less | 3. 5 years | 5. 9 years or more |
| 2. 3 years        | 4. 7 years |                    |
27. To date, what is your total flight time (military only) logged in R 'W aircraft?
- |                  |                    |                    |
|------------------|--------------------|--------------------|
| 1. 1-400 hours   | 3. 801-1200 hours  | 5. 1601-2000 hours |
| 2. 401-800 hours | 4. 1201-1600 hours | 6. 2001+           |
28. To date, what is your total flight time logged in AH-1's?
- |                  |                  |                  |
|------------------|------------------|------------------|
| 1. 1-150 hours   | 3. 301-450 hours | 5. 601-750 hours |
| 2. 151-300 hours | 4. 451-600 hours | 6. 750+          |
29. How many in-flight emergencies have you encountered while flying AH-1's?
- |        |          |                |
|--------|----------|----------------|
| 1. One | 3. Three | 5. Five        |
| 2. Two | 4. Four  | 6. Six or more |
|        |          | 7. None        |
30. How many of these emergencies resulted in aircraft damage?
- |        |          |                |
|--------|----------|----------------|
| 1. One | 3. Three | 5. Five        |
| 2. Two | 4. Four  | 6. Six or more |
|        |          | 7. None        |
31. How many of these emergencies resulted in crew injuries?
- |        |          |                |
|--------|----------|----------------|
| 1. One | 3. Three | 5. Five        |
| 2. Two | 4. Four  | 6. Six or more |
|        |          | 7. None        |
32. In how many of the in-flight emergencies would you have used an in-flight escape system had one been available?
- |   |                |
|---|----------------|
| 1. I experienced no in-flight emergency | 5. Three       |
| 2. None                                 | 6. Four        |
| 3. One                                  | 7. Five        |
| 4. Two                                  | 8. Six or more |
33. How many times have you experienced in-flight situations where the existence of an escape system aboard would have lessened the tension and anxiety by offering you an alternative if needed?
- |        |          |                |
|--------|----------|----------------|
| 1. One | 3. Three | 5. Five        |
| 2. Two | 4. Four  | 6. Six or more |
|        |          | 7. None        |
34. Do you agree that all attack helicopters should be equipped with in-flight escape systems?
- |                   |              |                      |
|-------------------|--------------|----------------------|
| 1. Strongly agree | 3. Undecided | 5. Strongly disagree |
| 2. Agree          | 4. Disagree  |                      |
35. Use the back of the answer sheet for remarks you feel appropriate for this survey.

# APPENDIX C

RESPONSE FROM 152 AVIATORS														
Brief Number	TIME			INJURY			USE							
	Yes--time sufficient to activate system	Undecided concerning time to use system	No--time insufficient for system use	Uninjured--ability to activate system unaffected	Doubtful concerning ability to activate system	Injured--could not activate system	Yes--no hesitation to activate system	Yes--prior to impact if other emergency procedures failed	Undecided concerning use of system	No--remain with aircraft	No system No benefit			
ACCIDENT REPORT INFORMATION (DA Form 2397)														
AIRCRAFT			JUDGED			INJURIES								
1	124	26	2	131	21	0	96	53	2	0	1	Total Loss	Nonsurvivable	2 Fatal
2	99	53	0	80	91	1	142	5	4	1	0	Total Loss	Nonsurvivable	2 Fatal
3	20	81	51	112	33	6	39	29	39	7	37	Total Loss	Nonsurvivable	2 Fatal
4	17	70	65	87	53	11	55	19	30	10	36	Total Loss	Nonsurvivable	2 Fatal
5	117	30	5	146	5	1	28	64	36	20	4	Total Loss	Survivable	2 Major
6	79	65	8	19	124	9	106	25	12	2	7	Total Loss	Survivable	1 Major, 1 Minor
7	30	65	57	94	24	34	27	30	37	3	54	Total Loss	Nonsurvivable	2 Fatal
8	27	96	29	94	51	105	12	5	0	29		Total Loss	Nonsurvivable	2 Fatal
9	147	4	1	149	3	0	52	70	17	11	2	Total Loss	Survivable	2 Major
10	111	30	0	25	123	3	112	36	6	1	1	Total Loss	Nonsurvivable	2 Fatal
11	131	14	7	139	12	0	37	46	37	23	8	Total Loss	Nonsurvivable	2 Fatal
12	56	71	25	92	55	4	50	30	34	19	19	Total Loss	Partially Survivable	1 Fatal, 1 Minor
13	146	6	0	152	0	0	136	16	0	0	0	Total Loss	Nonsurvivable	1 Fatal
14	136	16	0	152	0	0	87	53	8	3	1	Total Loss	Survivable	1 Major, 1 Minor
15	144	8	0	152	0	0	101	47	2	1	0	Total Loss	Nonsurvivable	2 Fatal
16	131	21	0	150	2	0	81	53	15	3	0	Total Loss	Survivable	2 Major
17	24	62	65	112	12	27	25	20	41	2	63	Total Loss	Nonsurvivable	2 Fatal
18	87	62	3	136	16	0	51	48	38	13	2	Total Loss	Survivable	1 Major, 1 Minor
19	58	79	15	117	32	3	108	21	10	1	12	Total Loss	Nonsurvivable	2 Fatal
20	125	26	1	151	1	0	18	15	49	65	5	Major Damage	Partially Survivable	1 Major, 1 Minor
21	145	6	1	152	0	0	19	47	37	44	5	Total Loss	Nonsurvivable	2 Fatal
22	142	7	3	149	2	1	22	26	53	44	7	Total Loss	Survivable	2 Major
23	70	65	17	120	28	4	19	19	57	35	21	Total Loss	Survivable	1 Major, 1 Minor
24	148	4	0	151	0	0	84	47	15	6	0	Total Loss	Nonsurvivable	1 Minor, 1 Minor
25	128	24	0	146	6	0	139	13	0	0	0	Total Loss	Nonsurvivable	2 Fatal

## APPENDIX D

### PILOT REMARKS.

1. I have seen a ship go down (hostile fire) with no power, on fire, no hydraulics, and loss of tail rotor thrust. That crew deserved, but did not have, an in-flight escape system. We need one.
2. Having been involved with parachutes and ejection systems for approximately 8 years while on duty with the Navy, I feel there is no excuse for the Army to not make the maximum effort possible for the protection of Army aviators. If only one life is saved, it will be a worthwhile effort.
3. Being unfamiliar with all aspects of a helicopter emergency escape system, I feel somewhat limited as to my viewpoint on this subject. Yet, it only stands to reason that any sort of emergency escape system would be helpful in lessening tension and anxiety during any emergency, simply because the pilot realizes he has an alternative. In some emergencies, I feel this system would probably represent a step forward in aircraft safety if its development, safeguards, and deployment were thoroughly proven. If all these requirements could be met, then I as a pilot of rotary wing aircraft would feel somewhat more secure.
4. I feel that all helicopters should be equipped with in-flight escape systems.
5. I feel question #33 sums up my feelings of an in-flight escape system. The tension during an emergency situation can be extremely high and an alternative to an uncontrollable aircraft or in-flight escape would be extremely welcomed on my part.
6. I feel that the in-flight escape system would afford me the opportunity to leave the aircraft in the event of the types of failure (main rotor blade or some tail rotor failures) that many times result in fatalities.
7. I feel that the in-flight escape system is long overdue.
8. The Army definitely needs an emergency system for escape. I bet you if the guys in this survey report were brought back from the dead (and the 1,000 others) brought back and filled out this survey there would be no doubt of the answer. It would be "YES."
9. This system is badly needed in the AH-1G. The Army is lagging way behind the other branches of the service (Air Force and Navy) in protecting their crews.
10. I feel that an emergency escape system for helicopters should be developed and installed. It would give the pilot an option not now available in situations where no other alternative is available. In many cases, the risk of going in with the aircraft even with the possibility of surviving would be far outweighed if an escape system were available.
11. It's a little late, but better late than never!
12. I think that unless a main blade is lost or cyclic control is lost I had rather autorotate. I had one AH-1 in Nam shot up so bad that autorotation into trees was necessary. Cyclic control required both hands to maintain control. After the crash, the aircraft was on its left side—main rotor gone—and tail stuck up in a tree. However, due to 50 cal. location and small arms fire, I

believe that I had rather autorotate than to use any type of ejection system in that situation. Also, question—After main rotor separation, how far will nose drop before ejection is completed?

13. No price should be placed on a human life. Situations occur where an ejection system is the only answer left. This option should be open to anyone who could use it.

14. Does this survey indicate that the Army is beginning to value its pilots more than its aircraft?

15. Some questions were answered both positive and negative for certain missing details. I definitely feel an extraction system is needed. However, a system would not prevent crews from getting target fixation or entering inadvertent IMC.

16. I would like to see a system incorporated which would allow a pilot that starts having problems at a safe altitude to bring the system up "hot" and then have the capability of punching out by a button on the cyclic at the very moment he decides the aircraft is going to impact hard no matter what he does. With this type of system, I feel the pilot would try to bring the aircraft down without damage.

17. It's about time the Army started thinking about its pilots.

18. Life of the pilots and their experience are more expensive in terms of replacement cost in the long run than one aircraft.

Flying an aircraft with such a system would keep me flying longer (number of years) and give my wife peace of mind.

19. In several of the situations mentioned in this survey, I assume that fatalities did occur. And in these cases, I strongly believe that the crew simply realized that essential control of the aircraft could not be retained or reestablished and they simply continued to make control inputs for the lack of something better to do before dying! I have personally witnessed several instances where the crew could have been saved if only an in-flight emergency egress system had been available!

20. I feel that the emergency escape system is a good idea; however, I don't think it is necessary. The money and time being spent on this system should be diverted to the study of stronger and more durable control tubes and mast. If this were done, the number of accidents causing injury or death would be greatly decreased.

In addition, some of the accidents in this brief occurred under IFR conditions. A radio or radar altimeter would be so much more beneficial than an escape system as to be uncomparable.

21. I feel that not only attack helicopters but all helicopters should be equipped with such a system. Just knowing that the system was there would be a great comfort in that you could attempt to correct for the emergency; and, if you failed or just didn't know what to do quick enough before becoming critical, you could punch out.

22. I would use the escape system if I lost my rotor head or flight controls. Any other emergency I would try to get the aircraft down without using the system.

23. I lost an engine in situation 23 with no injuries in a UH-1G. All my experience in AH-1G is as an IP or SIP in RVN on the AH-1G Training Team. Rest is in armed B&C models.

24. As a Cobra IP, I feel I could survive any emergency as long as the aircraft was not completely out of control or had blade separation. A Cobra pilot at Fort Campbell, however, does not practice autorotations and would probably be very happy to be able to use an escape system.

25. There would have to be a recondition of helicopter AH-1 pilots because they have become so used to thinking of the aircraft as a parachute.

26. Would like very much to see some type of in-flight escape system.

27. If such a system could save lives, then it is needed.

28. If new system could save lives--don't hesitate. IFR questions--difficult to answer--too many other existing circumstances unknown. As an IP in the AH-1G, I feel the failures scare pilots the most.

29. If it would save just one life, I wouldn't hesitate in having the system. The IFR questions are not good questions. Too many different things could really happen other than what was stated.

30. I believe that pilots would have a better chance of survival in mid-intensity warfare if an ejection or in-flight escape system were installed on attack helicopters.

31. I strongly agree that an in-flight escape system is a needed asset. In each of the in-flight emergencies I experienced, it would have been reassuring to know that I had the capability to use a system as described herein. I do not feel that consent for both pilots to activate the system is necessary. The decision to deploy should be left with the aircraft commander; however, the copilot should have the ability to activate the system in case of back seat incapability. The advantages of this system during an engine failure at night over unfriendly and unfamiliar terrain cannot be overemphasized. Blade separation and ejection must be accomplished with one cockpit movement.

32. I strongly feel that an emergency egress system is required, especially if we are to fly in a sophisticated antiaircraft environment. I base this on considerable experience in Laos, Cambodia, etc., in amongst the 37's, 57's.

I would have unhesitatingly left the aircraft (for sure) after being shot up, lost ADF, and inverted in severe turbulence while IFR in mountainous terrain coming out of the ASHAU.

33. I feel the in-flight escape system is an outstanding project; however, I feel if it were installed people would be using it for senseless emergencies. There are only a half dozen reasons the system should be used. I just hope when the system is employed people will use common sense.

34. With knowledge involving aircraft accidents into the trees, I have formed the opinion that without exception the aircraft suffers extensive damage. Therefore, I would recommend that if a crash into the trees is inevitable ejection from the aircraft is the only practical solution. The aircraft would be a total loss either way.

I sincerely hope to see this system installed in Army Cobras. To me, it's very practical in that it may save a life and that it'll improve the mission envelope of aircraft against sophisticated weapons.

35. More altitude information is needed.

36. Due to the use of NOE tactics, I suggest the system be automatically deployed upon the flameout of the engine. This could be done through the use of a (on-off) switch which could be controlled by the pilot at low altitude.

37. Something is better than nothing. Ask the Navy, Marines, Air Force, Coast Guard, Royal Air Force, etc.

38. I feel the in-flight emergency escape system would add another option to the pilot providing for more survivability. I think it should definitely have a "jettison select" capability with the following options available: (1) front seat only, (2) back seat only, (3) either seat. The selection should be made *before* flight not allowing for "changing minds" during flight or emergency situation. There should be visual indicators showing result of selection.

39. As with any tactical fighter type aircraft, exposure to enemy fire is to be expected in volume. The ability to "bail out" of a severely damaged or uncontrollable aircraft is an absolute necessity, so recognized by everyone but the Army. I would appreciate some consideration given to the cost per copy of a trained aviator who has lived through an *otherwise* fatal materiel failure rather than simply emphasis on the initial procurement costs of the aircraft.

40. I would heartily endorse the subject escape systems. The only situation which might render such system unusable would be sudden impact, such as IIR terrain strike or terrain strike at night. The system wouldn't help that old problem of target fixation unless the copilot could initiate ejection procedures for the crew. This would also be required when the pilot-in-command was injured and incapacitated.

41. One of my basic concerns regarding this system would be its maintenance. Presently, the maintenance system is having difficulty conducting the sophisticated aircraft we now possess. A very thorough training program would have to be initiated to condition pilots to use the system in a bona fide emergency.

42. In a situation where it is obvious that impacting the ground will result in destroying the aircraft and possibly injuring or killing crewmembers, such as autorotation into trees, water, etc., or unrecoverable loss of tail rotor or main rotor components, or engine failure in clouds over rough terrain, it is cost effective to save an expensively trained or experienced crew if at all possible.

43. Although on several of the statements I would have chosen to use the escape system, it should be noted that terrain would have been a deciding factor which was not mentioned in all accident briefs.

44. What about NOE flight at 0-20 kts? What good will the in-flight escape system do?

45. Briefs 3, 19, 20, 21. I believe I would have reacted in a different manner, with the end result hopefully being changed. I am also F W rated, and the ability to leave the aircraft in the event of an all-out emergency was a very definite psychological aid to me. All my emergencies in the AH-1G have been minor.